



# Benchmarking of countries' energy efficiency : “Right indicators for efficient benchmarking?”

A webinar for the Clean Energy Solutions Center

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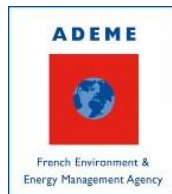
# Introduction

- About Enerdata:
  - Independent Information & Consulting firm specialising in the global energy industry and carbon market;
  - 25 years of experience in political, economic and technology issues related to climate and energy;
  - Analysis founded on advanced forecasting models, methodologies and databases.
- This energy efficiency benchmarking presentation relies on several projects carried out by Enerdata, among which:
  - ODYSSEE MURE supported by the Intelligent Energy Europe programme



<http://www.odyssee-indicators.org/>

- ADEME and WEC project on energy efficiency policy evaluation



# Webinar agenda

1. Introduction: energy efficiency targets and benchmarking in EU countries
2. Benchmarking of energy efficiency trends
3. Benchmarking of energy efficiency performance levels
4. Benchmarking of energy efficiency policy and measures
5. Conclusion: benchmarking of energy efficiency and quality of indicators

# 1. Energy efficiency targets and benchmarking

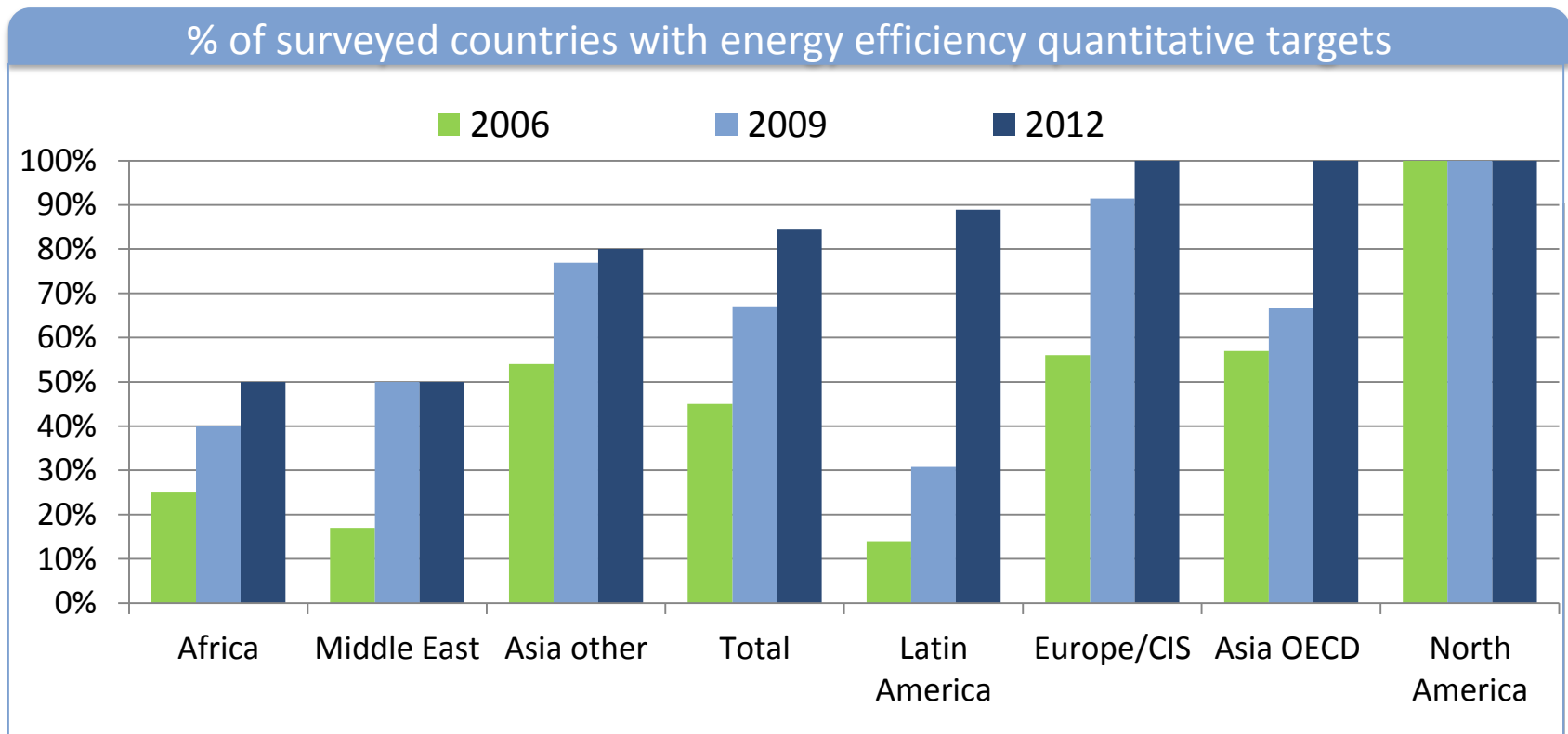
## 1.1. Energy efficiency targets in EU countries

- Strong commitment in energy efficiency in EU countries.
- EU policy has 3 main targets for 2020 known as “20\*20\*20”:
  - 20% share of renewables
  - 20% reduction in GHG emissions and
  - 20% energy savings.
- A new law adopted in October 2012, known as the Energy Efficiency Directive (EED), lists a set of requirements for EU member states to reach this 20% target.
- It replaces a previous directive, the Energy Service Directive (ESD), that fixed a target of 9% energy savings in 2016 for each member state compared to a reference consumption (5 years average, usually 2001-2005) to be made in domestic transport, buildings and small industries. In large industries already exist strong commitments with the ETS Directive (Emission Trading Scheme” capping CO2 emissions.

# 1. Energy efficiency targets and benchmarking

## 1.2. Energy efficiency targets at world level

At world level, there is also an increasing number of countries with energy efficiency targets (84% in 2012 compared to 45% in 2006), with a progression in all regions (e.g. in particular from 14% in 2006 to almost 90% in 2012 in Latin America).



# 1. Energy efficiency targets and benchmarking

## 1.3. *Need of benchmarking*

- In EU countries, the ESD and new EED directives impose to EU member countries a reporting to the European Commission every 3 years about their energy savings and the policy measures already implemented or planned in a document called the National Energy Efficiency Plans (NEEAPs).
- In other regions there is also an increasing need of reporting (at national or international level (e.g. NAMAS)).
- In this context, benchmarking becomes a key priority for a number of reasons:
  - To benchmark countries' performances in terms of energy efficiency achievements and understand which countries perform the best;
  - To benchmark policy measures, so as to see which measures are the most effective.

# 1. Energy efficiency targets and benchmarking

## 1.4. Benchmarking of energy efficiency performances

- Benchmarking can be done at different levels:
  - at a detailed level, such as an industrial branch (e.g. cement or pulp and paper) or an end-use (e.g. heating)
  - at an aggregate level such as a sector (e.g. industry, transport) or at the level of final consumers or of the total consumption → this presentation will focus on aggregate benchmarking.
- Benchmarking can be done:
  - in terms of level of performance or
  - in terms of rate of progress over a given period.
- A country may have a good performance at the present time but may not be improving its energy efficiency further whereas another country may have poor performance and improve its energy efficiency rapidly. Roughly speaking, new EU member countries from Central and Eastern Europe fall into that second category (as China at world level).

## 2. Benchmarking of energy efficiency trends

### 2.1. Energy intensity trends

- The simplest indicator generally used to benchmark energy efficiency trends is the annual variation relating the country's energy consumption to the GDP:
  - the primary energy intensity if one looks at the total consumption of the country (TPES or Total Primary Energy Supply), or
  - the final energy intensity if efficiency is considered at the level of final consumers.
- As energy efficiency agencies typically focus their programs on industry, buildings and transport, the benchmarking will often be done at final consumption level. Benchmarking will be done at the primary energy consumption level, if energy savings are also considered in energy transformations (e.g. power or refining sector).
- Energy efficiency improvement is then measured by a decrease in the primary or final intensities (less energy used per unit of GDP): a 1% reduction in the energy intensity will be considered as a 1% improvement in overall energy efficiency.



## 2. Benchmarking of energy efficiency trends

### 2.2. Energy intensity trends: example

The countries registering the largest “energy efficiency gains” are the ones showing the largest reduction, i.e. above 3%/year (case of China or most new EU member countries (e.g. the Baltic States, Bulgaria, Poland, Romania and Slovakia)).

#### Trends in primary energy intensity at world level (1990-2010)



## 2. Benchmarking of energy efficiency trends

### *2.3. From energy intensity trends to energy efficiency trends with ODEX*

- Energy efficiency improvement is not the only driver behind the energy intensity trends observed. Other potential factors are:
  - changes in the structure of the GDP;
  - changes in the specialization of industrial activities ; for instance, if a country has a strong growth in the production of electronic components, i.e a low energy intensity activity, and a low growth in the production of cement, its energy intensity will decrease, all things being equal, regardless of energy efficiency improvement ;
  - changes in the power mix, in the fuel mix of end users etc...
- In other words, the energy intensity trend only gives a rough proxy of energy efficiency gains.
- To assess and benchmark energy efficiency trends, EU countries are now using more sophisticated indicators, such as the energy efficiency ODEX developed in the framework of the ODYSSEE MURE project.

## 2. Benchmarking of energy efficiency trends

### 2.4. ODEX definition

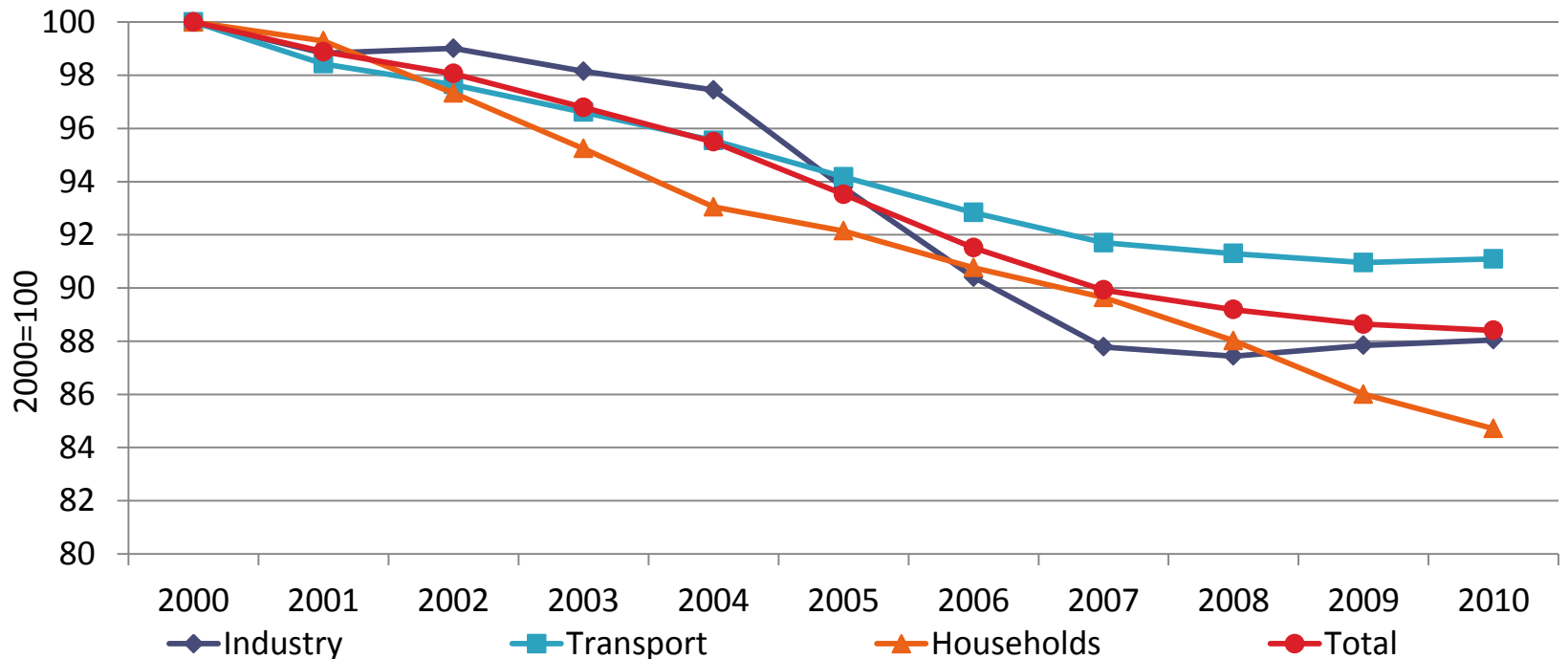
- ODEX is an index of energy efficiency progress
- It is calculated for each end-use sector (e.g. households, industry, transport, services) as follows:
  - Selection of indicators capturing energy efficiency improvement at a detailed level (end-uses, branches, modes of transport) (e.g. toe/m<sup>2</sup> for household space heating, kWh/refrigerator)
  - Calculation of an index of energy efficiency progress by end-use: for instance if the specific energy consumption for household space heating has decreased by 10% between 2000 and 2010, the index will be equal to 90 for household heating (with 2000 as the reference).
  - The energy efficiency index of the sector is calculated by weighting the progress for each end-use by their share in the sector's consumption: if for instance space heating represents 80% of household consumption, the contribution of the 10% progress for heating will be equal to 8% in the sector's index.

## 2. Benchmarking of energy efficiency trends

### 2.5. Calculation of total ODEX

- ODEX for final consumers is calculated by weighting the progress in each sector by their share in the final energy consumption.
- ODEX= 88 in 2010 → 12% energy efficiency improvement in 2010 ( 1.2%/yr over 2000-10)

Energy efficiency index (ODEX) for final consumers (EU)

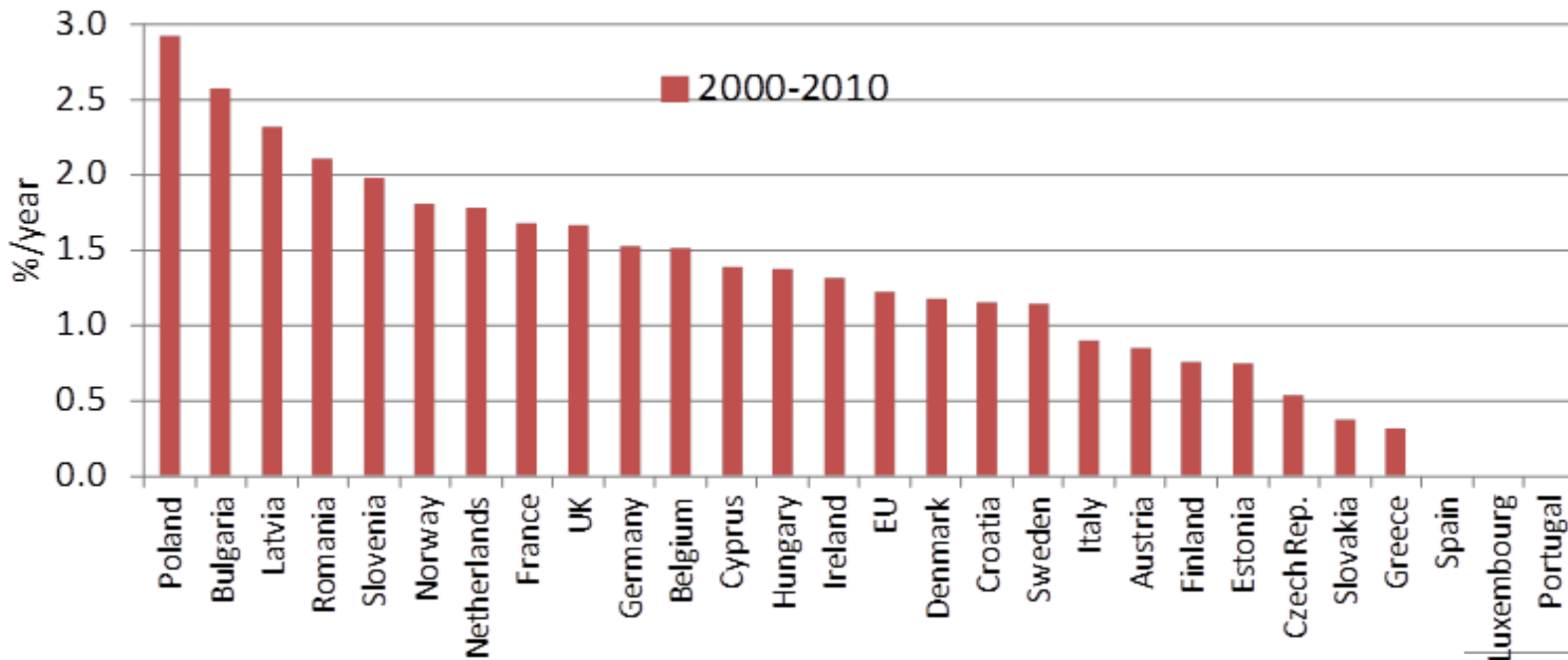


## 2. Benchmarking of energy efficiency trends

### 2.6. Measuring energy efficiency trends with ODEX: case of EU countries

- 5 new EU countries have registered rapid energy efficiency improvements (2 to 3%/yr): these good results are mainly explained by poor energy performance of infrastructures inherited from historically very low energy prices and the reforms implemented since then ;
- Among western EU countries, with a more similar level of development, The Netherlands stand out as the benchmark country in terms of energy efficiency progress, followed by France and UK.

Energy efficiency trends in EU countries (2000-2010)



## 3. Benchmarking of energy efficiency levels

### *3.1. From energy intensity to adjusted energy intensities*

- Accurate comparisons of energy efficiency performances can only be done at the sectoral or end-use level with technico-economic ratios rather than energy intensities.
- If one wants to benchmark final consumers as a whole, it is only possible to use energy intensities.
- The comparison can however be improved by introducing some adjustments to account for specific national characteristics, in terms of :
  - climate,
  - general price level,
  - GDP structure or
  - industrial specialization.

## 3. Benchmarking of energy efficiency levels

### 3.2. ODYSSEE adjusted final energy intensity: definition

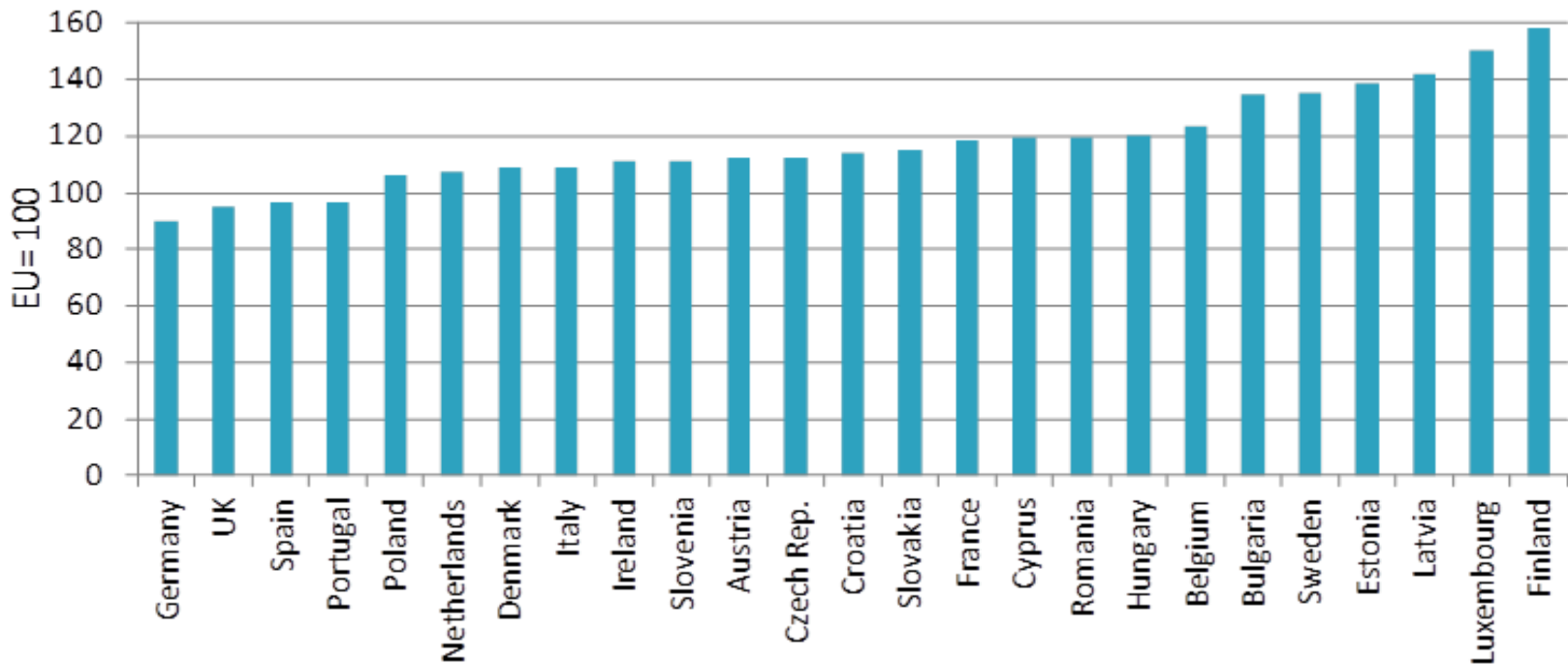
- Four types of adjustments are quantified in the ODYSSEE database to calculate an “adjusted” final energy intensity that is more relevant for countries’ benchmarking in Europe :
  - Conversion of the GDP in purchasing power parities to account for differences in the general price level (adjustment important for new member countries where the average price level can be up to three times lower than in western European countries) ;
  - Adjustment to the same heating requirements, based on the number of heating degree days, to account for climatic differences;
  - Adjustment to the same GDP structure (i.e. same share of services, industry and agriculture);
  - Finally adjustment to the same industry structures (i.e. same distribution of value added by branch) to account for differences in industrial activities.
- The reference for the adjustments is the EU average (i.e. average GDP structure, climate) .

# 3. Benchmarking of energy efficiency levels

## 3.3. ODYSSEE adjusted final energy intensity: example

- Germany appears as the country with the best energy efficiency performance in 2010, according to this adjusted final energy intensity, followed by UK and Spain.

Adjusted final energy intensities: indicator of benchmarking (2010) \*





## 3. Benchmarking of energy efficiency levels

### 3.4. ODYSSEE adjusted final energy intensity: caution

- Adjusted final energy intensities compare overall performances in energy productivity and not energy efficiency performances from a technical viewpoint.
- Several additional factors are still embedded in the relative values of these adjusted intensities, such as differences, for instance:
  - in the diffusion of household appliances and cars,
  - in behaviours (e.g. preference for large cars),
  - in the building stock structure (e.g. share of single family houses),
  - in the fuel mix or
  - in the process mix in industry.

## 4. Benchmarking of energy efficiency policies

### 4.1. How to do it?

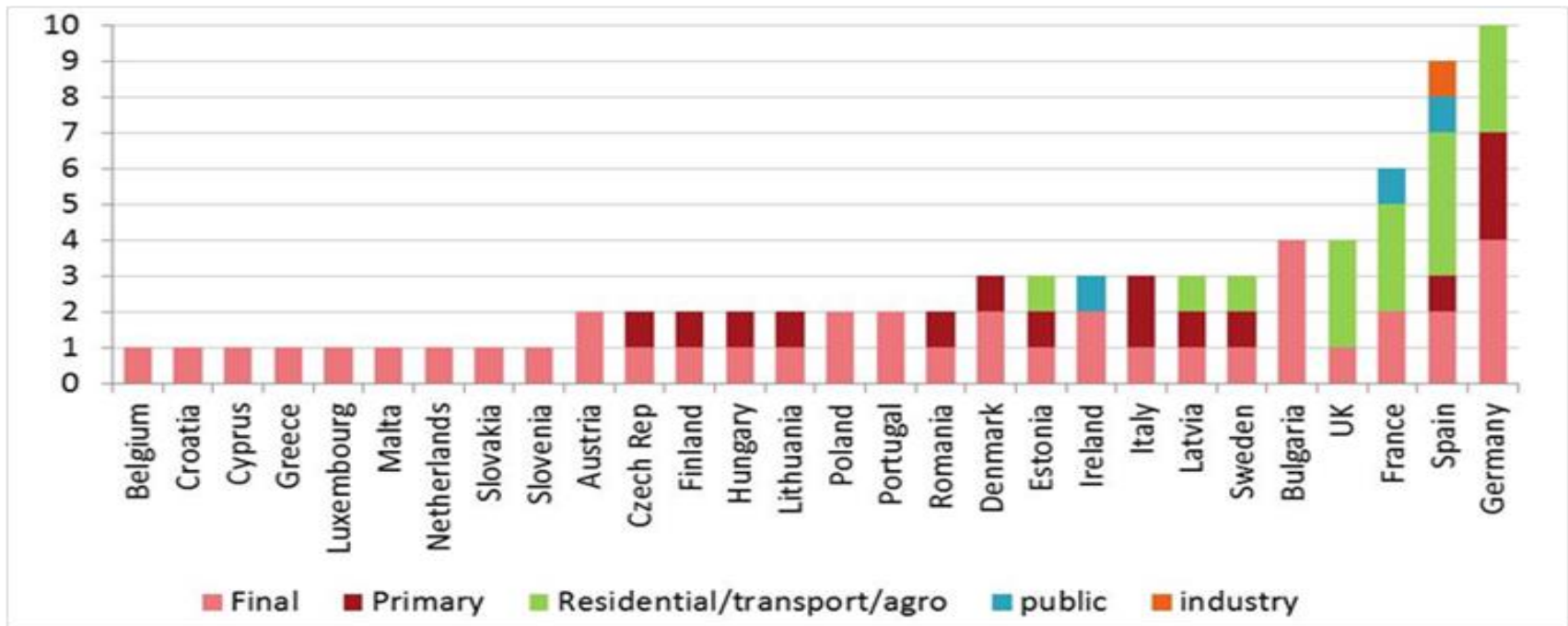
- Are the good results observed in terms of energy efficiency trends for The Netherlands, UK and France, and, in terms of level for Germany and UK, correlated to the energy efficiency policies implemented in these countries or to other factors, not quantified above? Then comes the question: how do we best benchmark these policies?
- To benchmark countries in terms of policies and measures on energy efficiency, we first have to define how to measure the policy intensity and effectiveness in the field of energy efficiency.
- Several indicators may be considered to assess this policy intensity:
  - Number of policy targets: a country with a wide range of ambitious targets may have a stronger commitment than a country with few or no target at all.
  - Number of measures according to their impacts (e.g. MURE data base):
    - Number of high impact measures;
    - Weighted impact ;
  - Energy efficiency Scoreboards;

## 4. Benchmarking of energy efficiency policies

### 4.2. Number of energy efficiency targets

Germany appears well as a country with a large number of targets, as well as France. However UK and the Netherlands, who experienced good results do not have many targets. This indicator alone is not sufficient to capture the policy intensity.

Number of policy targets in EU countries by type



## 4. Benchmarking of energy efficiency policies

### 4.3. Number of measures according to their impacts

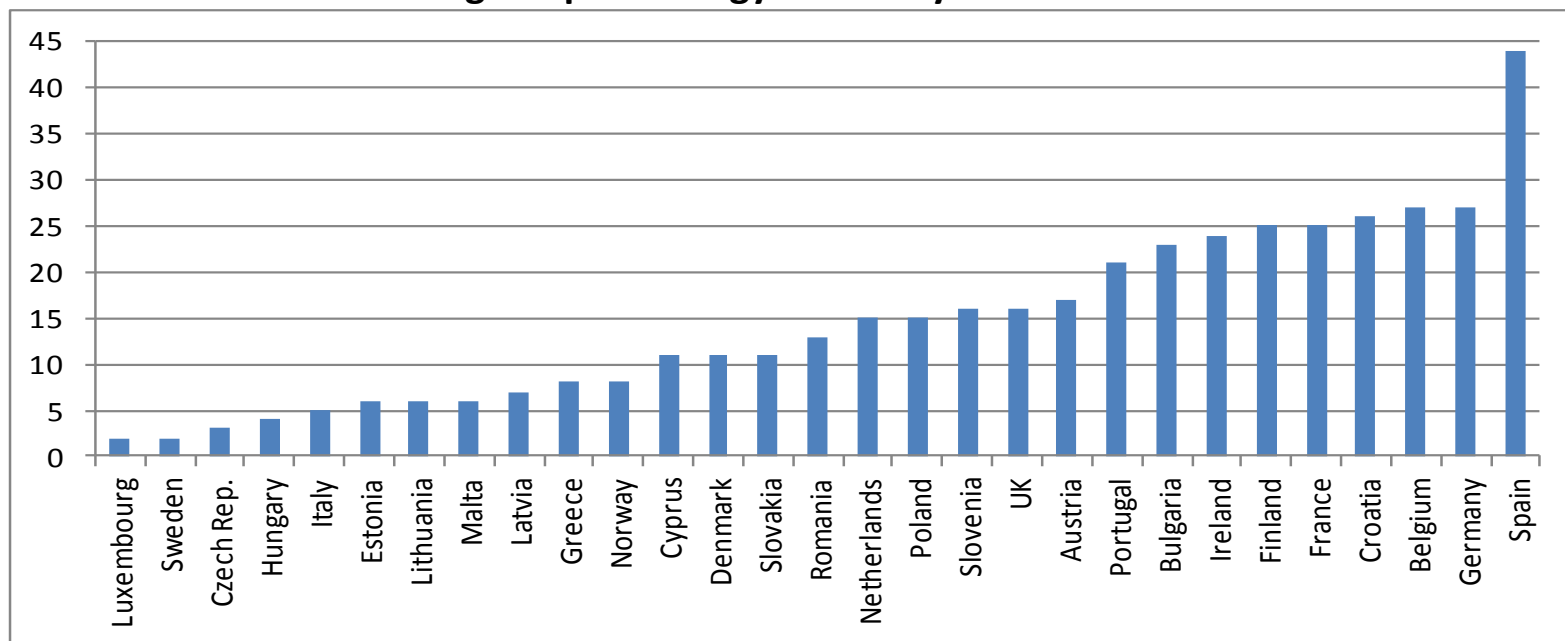
- Another indicator of the policy intensity could be the number of energy efficiency measures implemented in the different sectors: adding up the number of measures may not be a relevant indicator as some measures may have a stronger impact in terms of energy savings than others.
- We may therefore consider the **impact** of the measures implemented as an indicator, such as in the MURE policy database, in which each measure is classified according to its impact in terms of energy savings in relation to the total energy consumption of the sector with three levels:
  - **low impact:** savings < 0.1% of sector's consumption;
  - **medium:** savings between 0.1 and 0.5% of sector's consumption;
  - **high:** ≥0.5% of sector's consumption.
- The savings figures come from impact assessment studies. For measures without a quantitative evaluation of energy savings, the qualification is based on a semi-quantitative expert judgment.
- Therefore another approach to identify the most active countries and rank them according to the potential impact of their energy efficiency measures is to count the **number of high impact measures**.

## 4. Benchmarking of energy efficiency policies

### 4.3. Number of high impact measures: indicator of policy intensity

Spain turns out to have the most aggressive policy although this is not reflected so far in the results observed. It is followed by Germany. These two countries belong to the three most efficient countries according to the ranking made above with the adjusted final energy intensity. The third one, the UK, only arrives in the 9<sup>th</sup> position. The Netherlands are only in an intermediate position.

**Number of high impact energy efficiency measures in EU countries**

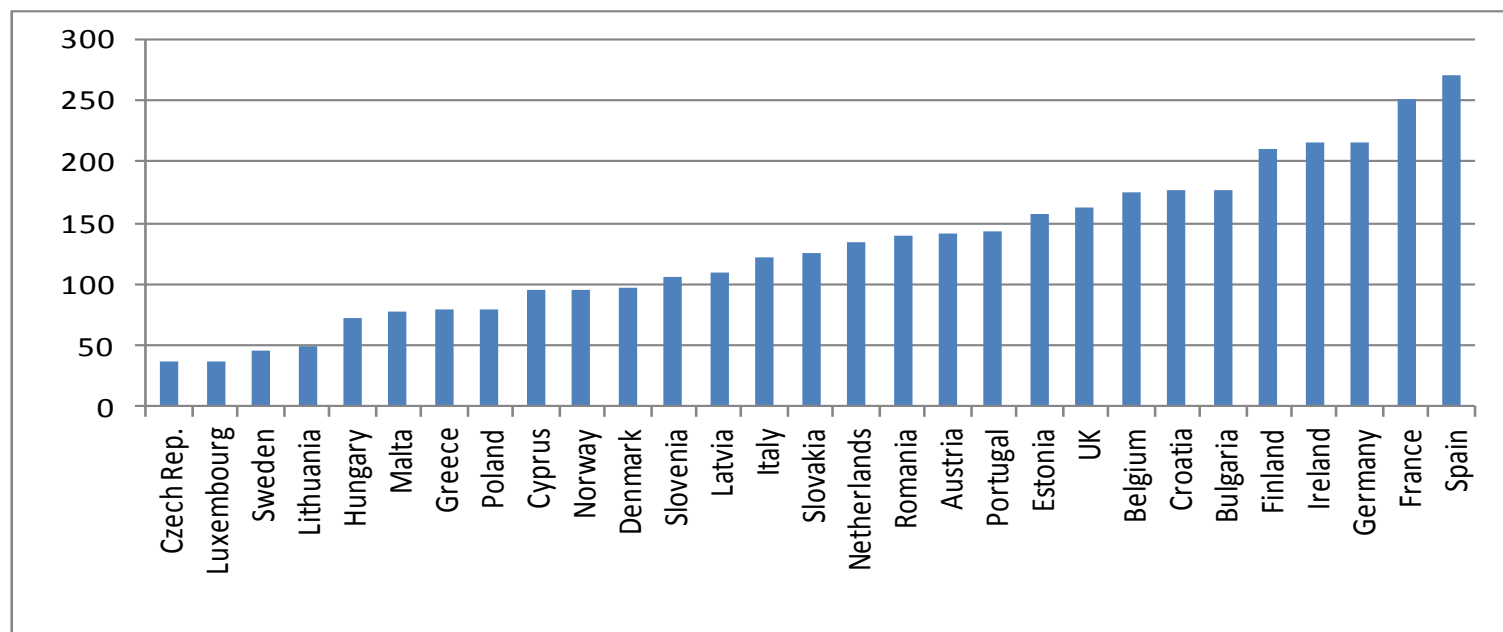


## 4. Benchmarking of energy efficiency policies

### 4.3 b. Weighted impact of measures: indicator of policy intensity

- A second approach, also used in the ODYSSEE MURE project, is to weight the number of measures according to their impact and calculate a composite indicator of impact.
- France now joins the two other countries that were already identified with high impact measures, Germany and Spain. UK and the Netherlands are still in an intermediate position.

**Indicator of impact of energy efficiency measures in EU countries**

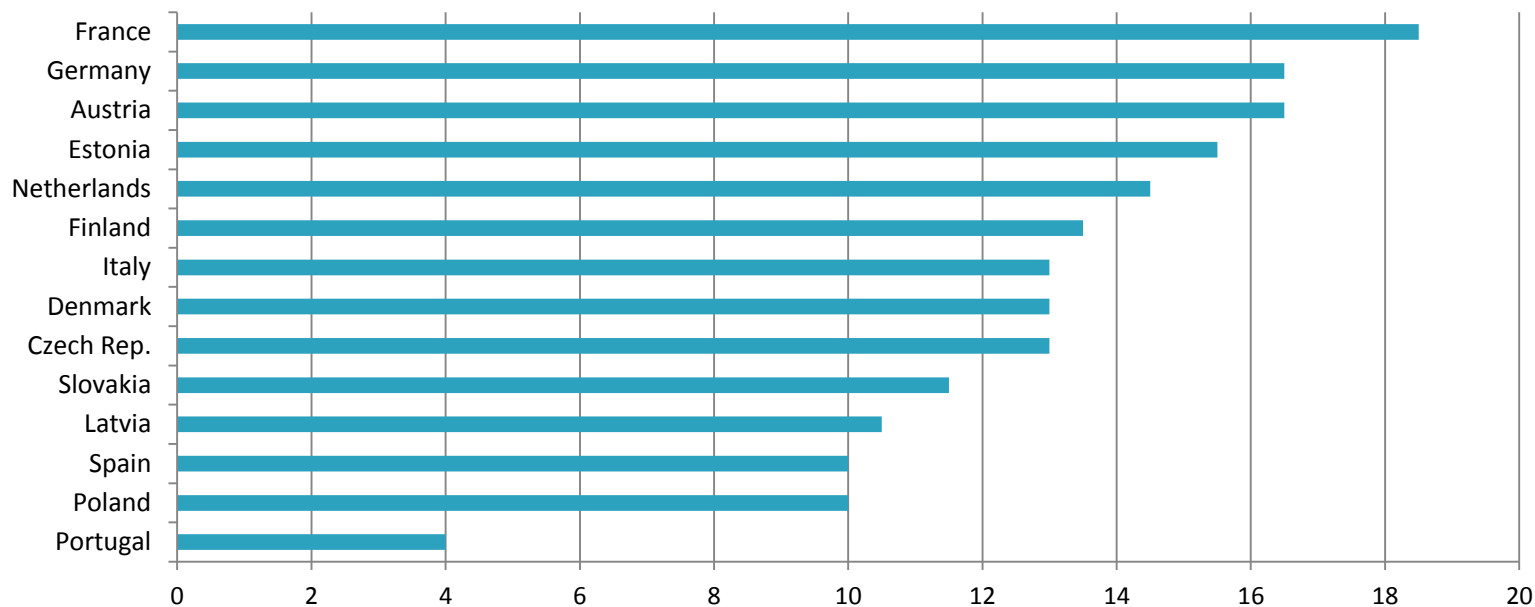


## 4. Benchmarking of energy efficiency policies

### 4.4. Energy Efficiency Watch Survey: European policy screening

- Objectives and scope: highlight strengths and weaknesses of European National Energy Efficiency policy ; identify policy gaps and give recommendations
- **National Energy Efficiency Action Plan (NEEAP) screening:** cross-country analysis **by sector** rated on a scale from 0 to 2 points → identify best practices

Example of results obtained in building sector for selected EU countries



# 4. Benchmarking of energy efficiency policies

## 4.7. State Energy Efficiency Scoreboard - USA

- Objective: comprehensive ranking of US states based on array of metrics that capture best practices and recognize leadership in EE policy
- USA score board: based on six main policy areas and 13 criteria in total, with different maximum total score /50

Table 1. Overall Methodology: Maximum Scores for each Policy Category

Policy	Maximum Score
<b>1. Utility and Public Benefits Programs and Policies</b>	<b>20</b>
Electricity Efficiency Program Budgets	5
Natural Gas Efficiency Program Budgets	3
Annual Savings from Electricity Efficiency Programs	5
Targets (Energy Efficiency Resource Standards)	4
Performance Incentives/Alternative Regulatory Business Models	3
<b>2. Transportation Policies</b>	<b>9</b>
<b>3. Building Energy Codes</b>	<b>7</b>
Level of Stringency	5
Enforcement/Compliance	2
<b>4. Combined Heat and Power</b>	<b>5</b>
<b>5. State Government Initiatives</b>	<b>7</b>
Financial and Information Incentives	3
Lead by Example in State Facilities and Fleets	2
Research, Development, and Demonstration	2
<b>6. Appliance and Equipment Efficiency Standards</b>	<b>2</b>
<b>Maximum Total Score</b>	<b>50</b>

Source: US States EE scoreboard

Table 30. Summary of Overall State Scoring on Energy Efficiency

Rank	State	Utility and Public Benefits Fund Efficiency Programs and Policies Score	Transportation Score	Building Energy Code Score	Combined Heat and Power Score	State Government Initiatives Score	Appliance Efficiency Standards Score	Total Score	Change in Rank from 2010	Change in Score from 2010
<i>Maximum Possible Points:</i>		20	9	7	5	7	2	50		
1	Massachusetts	18.5	7	7	5	7	1	45.5	1	3
2	California	17.5	8	7	4	5.5	2	44	-1	-1.5
3	New York	15	6	6	4	6.5	0.5	38	1	3.5
4	Oregon	13.5	6	7	4	6.5	0.5	37.5	-1	0.5
*5	Vermont	19	4	5	3	3	0	34	0	1
*5	Washington	13.5	6	7	4	3	0.5	34	1	2
*5	Rhode Island	18.5	5	5	3	2	0.5	34	2	5
*8	Minnesota	18	2	4	3	6	0	33	0	5
*8	Connecticut	12	6	5.5	5	3.5	1	33	0	5
↑10	Maryland	9.5	7	5.5	4	4	0.5	30.5	6	6.5



# Concluding remarks

- The analysis of the two indicators of policy impact shows that there is not always a correlation between a large set of high impact measures and the results observed.
- Can we conclude that countries may register good results although they do not seem to have a comprehensive set of measures?
- No we cannot come to such a decisive conclusion as the indicators used to measure the policy intensity are not perfect.
- First of all, measuring the intensity of a policy from the number of measures, even taking into account their impacts, may hide the fact that a single regulation may have a very strong impact on demand, if its requirements are very ambitious, while several regulations, that are badly enforced, or a large number of fiscal or financial incentives, that are not used by consumers, will have a limited impact on demand. In other words, quantity does not always mean quality.

## Concluding remarks (cont'd)

- Secondly, the assessment of the impact of measures is based on ex ante evaluations or expert judgment and may not be enough harmonized across countries, although some kind of harmonization is done in the MURE database.
- Although the indicators used for benchmarking the results achieved by the different countries in terms of energy efficiency progress and level are already quite advanced, they do not reflect 100% energy efficiency, as explained above for the adjusted intensity. The ODEX indicator may provide a more accurate vision of the real energy efficiency trends but will still embed the effect of non efficiency related factors that are difficult to correct, such as for instance, the effects linked to the economic crisis in Europe since 2009.
- The benchmarking of countries' energy efficiency performances should therefore be considered with care as it depends on the quality of the indicators used in the comparison.



Thank you for your attention !



[www.enerdata.net](http://www.enerdata.net)

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# Bibliography

- National Energy Efficiency Plans (NEEAPs) available by country at: [http://ec.europa.eu/energy/efficiency/end-use\\_en.htm#efficiency](http://ec.europa.eu/energy/efficiency/end-use_en.htm#efficiency).
- WEC activities on energy efficiency [http://www.worldenergy.org/activities/knowledge\\_networks/energy\\_efficiency/default.asp](http://www.worldenergy.org/activities/knowledge_networks/energy_efficiency/default.asp)
- WEC ADEME survey on energy efficiency policies: <http://www.wec-policies.enerdata.eu>
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- Definition of ODEX: [http://www.odyssee-indicators.org/registred/definition\\_odex.pdf](http://www.odyssee-indicators.org/registred/definition_odex.pdf)
- Review of EU policy targets on energy efficiency : <http://www.odyssee-indicators.org/publications/PDF/Task-4.1.1-Policy-targets-review-nov2011.pdf>
- MURE database on energy efficiency policy measures in EU countries <http://www.muredatabase.org/>
- Energy efficiency Watch: <http://www.energy-efficiency-watch.org/>
- IEA scoreboard: [http://iea.org/publications/freepublications/publication/IEA\\_Scoreboard2011.pdf](http://iea.org/publications/freepublications/publication/IEA_Scoreboard2011.pdf)
- USA scoreboard: <http://aceee.org/research-report/e115>

## 4. Benchmarking of energy efficiency policies

### 4.4. Energy Efficiency Watch Survey: highlighting strength and weaknesses

- Objectives and scope: highlight strengths and weaknesses of European National EE policy/ESD implementation ; identify policy gaps and give recommendations
- Approach combining several sources of information:
  - **National Energy Efficiency Action Plan (NEEAP) screening:** cross-country analysis by **sector** rated on a scale from 0 to 2 points (no aggregate ratings) → identify best practices

<b>Governance (/14)</b>	<b>Public (/12)</b>	<b>Buildings (/20)</b>	<b>Appliances (/12)</b>	<b>Industry (/18)</b>	<b>Transport (/12)</b>
Long term strategy	Public sector strategy	MEPS	MEPS	standards	planning instruments
other actors involved	role modal	other regulations	economic incentives	ES&A targets	regulatory instruments
energy agencies	mobility management	economic incentives	energy labels	obligations	economic incentives
coordination/financing	public procurement	EPCs	information tools	economic incentives	information
energy services	public buildings	advice and audits	education and training	tradable permits	R&D support
horizontal measures	adequacy of package	information	adequacy of package	energy taxation	adequacy of package
MRV		education & training		energy labeling	
		adequacy of package		other measures	
		Buildings		adequacy of package	

- Broad **survey among experts** on their EE policy perception (n=655)  
Ex: How do you see the improvement in actual implementation in the last 3 year?
- In **depth interviews with selected national experts** (3 per MS, ~80)

- With a focus on: Effective sectoral policy packages and governance framework